Method for separating gas mixtures, and a gas centrifuge for carrying out the method

Patent Claims

1. A method for separating gas mixtures by means of a gas centrifuge, in which a compressible process fluid is introduced into a double-walled rotor in which, as a consequence of the centrifugal forces that act, the process fluid is compressed and separated, at the same time resulting in the gas molecules with a higher molecular weight which are contained in the gas mixture being enriched along the outer wall of the rotor, and in portions of the process fluid which each have different contents of the components contained in the gas mixture being carried away separately, **characterized in that** the process fluid is introduced from an axial central supply tube (1) into the widening enveloping area (2) of the compression area (A) of a double-walled centrifuge rotor (3), with the gas mass flow being shaped and positively guided on a circular path as the axial distance increases through the flow channels (6) in the compression area (A),
in that the process fluid is carried with a constant flow cross section (4) in the centrifuged state in the double tube in flow channels (6) in the area (B) of the double-walled centrifuge rotor (3) remote from the axis,
in that, in the centrifuged state, the gas flow is separated into a relatively heavy gas fraction and a relatively light gas fraction at a separating threshold (8) which is dependent on the proportion by volume of the individual gases,
in that, seen in the flow direction, the separate gas fractions are positively guided, braked and carried away separately with decreasing axial distance in the flow channels (6) upstream of the transition from the

area (B) remote from the axis to the expansion area (C), and

in that the acceleration of the gas molecules in the compression area (A) and the braking of the gas fractions in the expansion area (C) are proportional to the mass.

2. A method for separating gas mixtures by means of a gas centrifuge, in which a compressible process fluid is introduced into a double-walled rotor in which, as a consequence of the centrifugal forces that act, the process fluid is compressed and separated, at the same time resulting in the gas molecules with a higher molecular weight which are contained in the gas mixture being enriched along the outer wall of the rotor, and in portions of the process fluid which each have different contents of the components contained in the gas mixture being carried away separately, **characterized in that** the process fluid is introduced from an axial central supply tube (1) into the widening enveloping area (2) of the compression area (A) of a double-walled centrifuge rotor (3), with the flow cross section (4) for the process fluid being proportional to the volume flow in the flow channels (6) in the compression area (A),

in that, in the area (B) of the double-walled centrifuge rotor (3) remote from the axis, the process fluid is carried in the double tube in flow channels (6) in proportion to the volume flow with a reducing flow cross section (4), and

in that, seen in the flow direction, the process fluid is separated into a relatively heavy and into a relatively light gas fraction at a separating threshold (8), which is arranged concentrically as a function of the proportion by volume of the individual gases, upstream of the transition from the area (B) remote from the axis to the expansion area (C) of the double-walled centrifuge rotor (3).

3. A method for separating gas mixtures by means of a gas centrifuge, in which a compressible process fluid is introduced into a double-walled rotor in which, as a consequence of the centrifugal forces that act, the process fluid is compressed and separated, at the same time resulting in the gas molecules with a higher molecular weight which are contained in the gas mixture being enriched along the outer wall of the rotor, and in portions of the process fluid which each have different contents of the components contained in the gas mixture being carried away separately, **characterized in that** the process fluid is introduced from an axial central supply tube (1) into the widening enveloping area (2) of the compression area (A) of a double-walled centrifuge rotor (3), with the flow cross section (4) for the process fluid being inversely proportional to the pressure in the flow channels (6) in the compression area (A),
in that, in the area (B) of the double-walled centrifuge rotor (3) remote from the axis, the process fluid is carried in the double tube in flow channels (6) with a flow cross section (4) which decreases in inverse proportion to the pressure, and
in that, seen in the flow direction, the process fluid is separated into a relatively heavy and into a relatively light gas fraction at a separating threshold (8), which is arranged concentrically as a function of the proportion by volume of the individual gases, upstream of the transition from the area (B) remote from the axis to the expansion area (C) of the double-walled centrifuge rotor (3).

4. The method for separating gas mixtures by means of a gas centrifuge as claimed in one of claims 1 to 3, **characterized in that** the process fluid is carried in flow channels (6), which are formed between webs (5) parallel to the axis, in the double-walled centrifuge

rotor (3).

5. The method for separating gas mixtures by means of a gas centrifuge as claimed in one of claims 1 to 4, **characterized in that** the process fluid in the central supply tube (1) and/or in the central outlet tube (10) by the use of axial fans (11) whose differential pressure is increased in order to overcome the flow losses throughout the entire centrifuge.

6. The method for separating gas mixtures by means of a gas centrifuge as claimed in one of claims 1 to 5, **characterized in that** the individual fractions of the gas mixture are carried in flow channels (6) which are separated from one another in the expansion area (C), and are introduced separately into the central outlet tube (10).

7. A gas centrifuge for carrying out the separation of gas mixtures as claimed in one of claims 1 to 3, comprising a gas-carrying double-walled centrifuge rotor, which is in the form of a rotating drum, as part of an electric-motor drive, **characterized in that** the area which carries the process fluid within the double wall of the double-walled centrifuge rotor (3) is equipped in the compression area (A) with an annular flow cross section (4) which is proportional to the mass flow until the area (B) which is remote from the axis is reached,
in that the area (B) of the double wall of the double-walled centrifuge rotor (3) which is remote from the axis and carries the process fluid is equipped with an annular flow cross section (4) which is proportional to the mass flow as far as the start of the expansion area (C), and thus remains the same, and
in that, seen in the flow direction, a separating threshold (8) which is concentric as a function of the proportion by volume of the individual gases is

arranged upstream of the transition from the area (B) of the double wall of the double-walled centrifuge rotor (3) which is remote from the axis to the expansion area (C).

8. A gas centrifuge for carrying out the separation of gas mixtures as claimed in one of claims 1 to 3, comprising a gas-carrying double-walled centrifuge rotor, which is in the form of a rotating drum, as part of an electric-motor drive, **characterized**
in that the area within the double wall of the double-walled centrifuge rotor (3) which carries the process fluid is equipped in the compression area (A) with an annular flow cross section (4) which is proportional to the volume flow until the area (B) remote from the axis is reached, and thus tapers,
in that the area (B) of the double wall of the double-walled centrifuge rotor (3) which is remote from the axis and carries the process fluid is equipped with an annular flow cross section (4) which is proportional to the volume flow as far as the start of the expansion area (C), and
in that, seen in the flow direction, a separating threshold (8) which is concentric as a function of the proportion by volume of the individual gases is arranged upstream of the transition from the area (B) of the double wall of the double-walled centrifuge rotor (3) which is remote from the axis to the expansion area (C).

9. A gas centrifuge for carrying out the separation of gas mixtures, comprising a gas-carrying double-walled centrifuge rotor, which is in the form of a rotating drum, as part of an electric-motor drive, **characterized**
in that the area within the double wall of the double-walled centrifuge rotor (3) which carries the process fluid is equipped in the compression area (A) with an

annular flow cross section (4) which is inversely proportional to the pressure until the area (B) remote from the axis is reached, and thus tapers,

in that the area (B) of the double wall of the double-walled centrifuge rotor (3) which is remote from the axis and carries the process fluid is equipped with an annular flow cross section (4) which is inversely proportional to the pressure as far as the start of the expansion area (C), and

in that, seen in the flow direction, a concentric separating threshold (8) is arranged upstream of the transition from the area (B) of the double wall of the double-walled centrifuge rotor (3) which is remote from the axis to the expansion area (C).

10. The gas centrifuge for separating gas mixtures as claimed in one of claims 7 to 9, **characterized in that** the axis (12) of the centrifuge rotor (3) is arranged vertically.

11. The gas centrifuge for separating gas mixtures as claimed in one of claims 7 to 10, **characterized in that** webs (5), which are used to ensure that the process fluid flows with little turbulence, are arranged continuously and are parallel to the axis, are formed within the walls of the double-walled centrifuge rotor (3).

12. The gas centrifuge for separating gas mixtures as claimed in one of claims 7 to 11, **characterized in that** the stationary housing (8) of the gas centrifuge is connected in a gas-tight manner to the central supply and outlet tubes (1, 10) which carry the process fluid.

13. The gas centrifuge for separating gas mixtures as claimed in one of claims 7 to 12, **characterized in that** the central supply and outlet tubes (1, 10) which carry the process fluid are connected without contact to the

centrifuge rotor (3) by means of labyrinth seals (15).

14. The gas centrifuge for separating gas mixtures as claimed in one of claims 7 to 13, **characterized in that** flow channels (6) which are separated from one another are arranged in the expansion area (C) for transportation of the gas fractions which are obtained at the separating threshold (9) and have different density.

15. The gas centrifuge for separating gas mixtures as claimed in one of claims 7 to 14, **characterized in that** an annular channel (9), which is used for holding the relatively heavy gas fraction, is arranged in the central outlet tube (10).

16. The gas centrifuge for separating gas mixtures as claimed in one of claims 7 to 15, **characterized in that** an extraction nozzle (13), which is used for extraction of the relatively heavy gas fraction, is arranged on the central outlet tube (10) which is used at the outlet (14) for the relatively light gas fraction.